BS ISO 15179:2012

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Hot-rolled twin-roll cast steel sheet of structural quality and high strength steel

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National foreword

This British Standard is the UK implementation of ISO 15179:2012.

The UK participation in its preparation was entrusted to Technical Committee ISE/109, Coated and Uncoated Flat Products to be Used for Cold Forming.

A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

ISO 15179

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Hot-rolled twin-roll cast steel sheet of structural quality and high strength steel

Tôles en acier de construction et en acier à haute résistance laminées à chaud par coulée entre cylindres

Reference number
ISO 15179:2012(E)

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15179 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

INTERNATIONAL STANDARD ISO 15179:2012(E)

Hot-rolled twin-roll cast steel sheet of structural quality and high strength steel

1 Scope

This International Standard specifies the characteristics of hot-rolled twin-roll cast steel sheet of structural quality and high strength steel. The product is intended for applications where specific mechanical properties are required. It is generally used in the delivered condition and is intended for bolted, riveted or welded structures. This product is produced on a wide strip mill, not a plate mill.

Structural quality twin-roll cast steel sheet is a carbon steel produced to specified mechanical properties and is available in a number of grades (see Table 5).

High strength twin-roll cast steel sheet, strengthened by microalloys, is produced to specified mechanical properties and is available in a number of grades and classes (see Table 6).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 16160, *Hot-rolled steel sheet products — Dimensional and shape tolerances*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
microalloying element
element, such as niobium, vanadium, titanium, added singly or in combination to obtain higher strength levels combined with better formability, weldability and toughness as compared with non-alloy steel produced to equivalent strength

3.2
hot-rolled descaled steel sheet
hot-rolled steel sheet from which oxide or scale has been removed, commonly by pickling in an acid solution

3.3
mill edge
normal side edge without any definite contour produced in hot rolling

NOTE Mill edges may contain some irregularities, such as cracked or torn edges or thin (feathered) edges.

3.4
sheared edge
edge product normal edge obtained by shearing, slitting or trimming a mill edge product

NOTE Normal processing does not necessarily provide a definite positioning of the slitting burr.

3.5
twin-roll cast steel sheet
steel sheet produced by casting to near final thickness directly from the liquid metal with minimal hot rolling to achieve the final thickness

4 Thickness

4.1 This product is commonly produced in thicknesses from 0,7 mm to 2,0 mm, inclusive, and widths of up to 2 000 mm maximum.

4.2 Hot-rolled sheets less than 600 mm wide may be slit from wide sheets and may be considered sheets.

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed by the interested parties, processes used in making the steel and in manufacturing hot-rolled sheet are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steel-making process being used.

5.2 Chemical composition

The chemical composition (heat analysis) shall not exceed the values given in Tables 1, 2 and 3.

5.3 Chemical analysis

5.3.1 Heat analysis

A heat analysis of each heat of steel shall be carried out by the manufacturer in order to determine the percentage of all appropriate elements listed in Tables 1, 2 and 3. On request, this analysis shall be reported to the purchaser or his representative.

5.3.2 Product analysis

A product analysis may be carried out by the purchaser in order to verify the specified analysis of the product. For killed steels, the sampling method shall be agreed upon between the interested parties at the time of ordering. The product analysis tolerances shall be in accordance with Table 4.

Table 1 — Chemical requirements — Heat analysis structural quality[a]

Mass fractions in per cent maximum

	Class	C	Mn	P	S	Si
All grades	A	0,25	1,35	0,040	0,035	–

[a] Where the "–" appears in this table, there is no requirement, but the analysis shall be reported.

Table 2 — Chemical requirements[a] — Heat analysis — High strength steel

Mass fractions in per cent maximum

Designation	C	Mn	P	S	Si[a]	V[d] min.	Ti[d] min.	Nb[d] min.	N[a]
HSS[c]									
Grade 310 Class 1[b]	0,22	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 310 Class 2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 340 Class 1[b]	0,23	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 340 Class 2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 380 Class 1[b]	0.25	1,35	0,04	0,04	–	0,008	0,00	0,008	–
Grade 380 Class 2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
Grade 410 Class 1	0,26	1,50	0,04	0,04	–	0,008	0,008	0,008	–
Grade 410 Class 2	0,15	1,50	0,04	0,04	–	0,008	0,008	0,008	–
Grade 450 Class 1	0,26	1,50	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 450 Class 2	0,15	1,50	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 480 Class 1	0,26	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 480 Class 2	0,15	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 550 Class 1	0,26	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
Grade 550 Class2	0,15	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]

[a] Where the "–" appears in this table, there is no requirement, but the analysis shall be reported.

[b] For each reduction of 0,01 % below the specified carbon maximum, an increase of 0,06 % manganese above the specified maximum shall be permitted up to a maximum of 1,50 %.

[c] The purchaser has the option of restricting the nitrogen content. It should be noted that, depending on the microalloying scheme (for example use of vanadium) of the producer, nitrogen is permitted as a deliberate addition. Consideration should be given to the use of nitrogen-binding elements (for example vanadium and titanium).

[d] The producer shall add at least one or more of the elements V, Ti or Nb.

Table 3 — Limits on additional chemical elements[a] — Structural quality

Mass fractions in per cent

Element	Cu max.	N max.	Cr max.	Nb max.	Mo max.	V max.	Ti max.
Heat analysis	0,50	0,30	0,30	0,008	0,15	0,008	0,008
Product analysis	0,53	0,33	0,34	0,018	0,16	0,018	0,018

[a] Each of the elements listed in this table shall be included in the report of the heat analysis. Where the amount of copper, nickel, chromium or molybdenum is less than 0,02 %, the analysis shall be reported as 0,02 %.

Table 4 — Product analysis tolerances

Element	Maximum of specified element %	Tolerance over the maximum specified %
Carbon	≤ 0,26	0,04
Manganese	≤ 01,65	0,05
Phosphorus	≤ 0,04	0,01
Sulfur	≤ 0,04	0,01
NOTE The maximum tolerance in this table is the allowable excess over the specified requirement and not the heat.		

5.4 Weldability

This product is normally suitable for welding if appropriate welding conditions are selected. For non-descaled steel, it may be necessary to remove the scale or oxide depending upon the welding method. As the carbon increases above 0,15 %, spot welding becomes increasingly difficult.

5.5 Application

It is desirable that hot-rolled twin-roll cast steel sheet be identified for fabrication by the name of the part or by the intended application. Proper identification of the part may include visual examination, prints or description, or a combination of these.

5.6 Mechanical properties

5.6.1 At the time that the steel is made available for shipment, the mechanical properties shall be as stated in Tables 5 and 6, where they are determined on test pieces obtained in accordance with the requirements of Clause 7.

5.6.2 Either Re_L or Re_H may be specified, but not both.

Table 5 — Mechanical properties of structural quality twin-roll cast steel sheet

Grade	R_e min.[a] MPa	R_m min. MPa	A, min.[b] $e \leq 2$ mm	
			$L_o = 50$ mm	$L_o = 80$ mm
HR275	275	380	15	14
HR340	340	340	9	8
HR380	380	380	8	7
HR410	410	410	7	6
HR480	480	480	6	5
HR550	550	550	5	4

R_e = lower yield strength

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

e = thickness of steel sheet, in millimetre(s)

1 MPa = 1 N/mm^2

[a] The yield stress specified in this table shall be the lower yield stress, R_{el}. The values may also be measured by 0,5 % total elongation proof stress (proof stress under load) or by 0,2 % offset where a definite yield phenomenon is not present. Where upper yield stress, R_{eH}, is specified, the values shall be 20 N/mm^2 above the R_{el} values for each grade.

[b] Use either $L_o = 50$ mm or $L_o = 80$ mm to measure elongation. For material up to and including 0,6 mm in thickness, the elongation values in this table shall be reduced by 2.

Table 6 — Mechanical properties for hot-rolled twin-roll cast high strength steel sheet

Grade	R_e min.[a] MPa	R_m min. MPa	A min.[b] $e \leq 2$	
			$L_o = 50$ mm	$L_o = 80$ mm
HSS 310 Class 1	310	410	18	17
HSS 310 Class 2	310	380	18	17
HSS 340 Class 1	340	450	15	14
HSS 340 Class 2	340	410	15	14
HSS 380 Class 1	380	480	13	12
HSS 380 Class 2	380	450	13	12
HSS 410 Class 1	410	520	11	10
HSS 410 Class 2	410	480	11	10
HSS 450 Class 1	450	550	10	9
HSS 450 Class 2	450	520	10	9
HSS 480 Class 1	480	585	8	7
HSS 480 Class 2	480	550	8	7
HSS 550 Class 1	550	565	7	6
HSS 550 Class 2	550	620	7	6

R_e = yield strength

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

e = thickness of steel sheet, in millimetre(s)

1 MPa = 1 N/mm^2

[a] The yield strength may be measured either by 0,5 % elongation proof stress, $R_{t0,5}$ (proof stress under load) or by 0,2 % offset, $R_{p0,2}$, where a definite yield strength phenomenon is not present.

[b] For thicknesses up to 2 mm, use either $L_o = 50$ mm or $L_o = 80$ mm. In cases of dispute, however, only the results obtained on a 50 mm test piece shall be valid.

5.7 Surface condition

Oxide or scale on hot-rolled steel sheet is subject to variations in thickness, adherence and colour. Removal of the oxide or scale by pickling or grit blasting can disclose surface imperfections not readily visible prior to this operation.

5.8 Oiling

As a deterrent to rusting, a coating of oil is usually applied to hot-rolled twin-roll cast descaled steel sheet, but may be furnished not oiled, if required. The oil is not intended as a forming lubricant and shall be easily removable using degreasing chemicals. On request, the manufacturer shall advise the purchaser which type of oil has been used. Hot-rolled twin-roll cast descaled sheet may be ordered not oiled; in which case, the supplier has limited responsibility if oxidation occurs.

6 Dimensional tolerances

Dimensional tolerances applicable to hot-rolled steel sheets shall be as given in ISO 16160.

Restricted thickness tolerances are given in ISO 16160.

7 Sampling

One representative sample for the tensile test required in Tables 5 and 6 shall be taken from each lot of sheet for shipment. A lot consists of 50 t, or less, of the same grade and class rolled to the same thickness and condition.

8 Mechanical property tests

8.1 General

The tensile test shall be carried out in accordance with ISO 6892-1. Transverse test pieces shall be taken midway between the centre and the edge of the sheet as rolled.

8.2 Retests

If a test does not give the specified results, two more tests shall be taken at random on the same lot. Both retests shall conform to the requirements of this International Standard; otherwise, the lot may be rejected.

8.3 Machining and flaws

If any test piece shows defective machining or develops flaws, it shall be discarded and another test piece substituted.

8.4 Elongation

If the percentage elongation of any test piece is less than that specified in Tables 5 and 6 and if any part of the fracture is outside the middle half of the gauge length as scribed before the test, the test shall be discarded and a retest shall be carried out.

9 Resubmission

9.1 The manufacturer may resubmit for acceptance, the products that have been rejected during earlier inspection because of unsatisfactory properties after he/she has subjected them to a suitable treatment (e.g. selection and heat treatment) which, on request, shall be indicated to the purchaser. In this case, tests shall be carried out as if they applied to a new batch.

9.2 The manufacturer shall have the right to subject the rejected products to a new examination for compliance with the requirements for another grade.

10 Workmanship

The surface condition shall be that normally obtained in a hot-rolled twin-roll cast product or hot-rolled descaled product.

The steel sheet in cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing.

Processing for shipment in coils does not afford the manufacturer an opportunity to observe readily, or to remove, defective portions; however, this is possible with the cut-length product.

11 Inspection and acceptance

While not usually required for products covered by this International Standard, where the purchaser specifies that inspection and tests for acceptance be observed prior to shipment from the manufacturer's works, the manufacturer shall provide the purchaser's inspector with all reasonable facilities to determine that the steel is being furnished in accordance with this International Standard.

Steel that is reported to be defective after arrival at the user's works shall be set aside, properly and correctly identified and adequately protected. The supplier shall be notified in order that he may properly investigate.

12 Coil size

Where hot-rolled twin-roll cast steel sheet is ordered in coils, a minimum inside diameter (ID) or a range of acceptable inside diameters shall be specified. In addition, the maximum outside diameter (OD) and maximum acceptable coil mass shall be specified.

13 Marking

Unless otherwise stated, the following minimum requirements for identifying the steel shall be legibly stencilled on the top of each lift or shown on a tag attached to each coil or shipping unit:

a) the manufacturer's name or identifying brand;

b) a reference to this International Standard, i.e. ISO 15179:2012;

c) the grade and class designations;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

14 Information to be supplied by the purchaser

To specify requirements adequately in accordance with this International Standard, inquiries and orders shall include the following information:

a) a reference to this International Standard, i.e. ISO 15179:2012;

b) the name, quality, grade and class of the material (e.g. hot-rolled twin-roll cast steel sheet, structural quality and grade HR550);

c) the dimensions of the product and the quantity required;

d) the application (name of part), if possible (see 5.5);

e) whether pickling or descaling by grit or shot blasting is required (see 5.7); material so specified shall be oiled, unless upon ordering it is specified as not oiled) (see 5.8);

f) the type of edge (see 3.3 and 3.4);

g) whether or not crop ends are required;

h) the report of the mechanical properties and/or heat analysis, if required (see 5.6 and 5.3.1);

i) limitations on mass and dimensions of individual coils and bundles, if applicable (see Clause 12);

j) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see Clause 11);

k) specification of whether R_{eH} or R_{eL} (see 5.6.2).

EXAMPLE The following is a typical ordering description:

International Standard ISO 15179:2012, hot-rolled twin-roll cast steel sheet, structural quality, grade HR550, 3 × 1 200 × 2 440, 40,000 kg, for pat number 2345, roof support, mill edge, furnish report of mechanical properties, maximum lift 4 000 kg.

Bibliography

[1] ASTM A1039/A1039M-10, *Standard Specification for Steel, Sheet, Hot- Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, Produced by the Twin-Roll Casting Process*[1)]

1) This document is recognized by ISO/TC 17/SC 12 to cover a subject similar to that of this International Standard. This information is given for the convenience of users of this International Standard and constitutes neither an endorsement of the document by TC 17/SC 12 or ISO, nor a statement regarding its degree of equivalence with this International Standard.

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BSI Group Headquarters

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